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Network-Level Pavement Condition Data Quality Management Program

Agency Name: Arizona Department of Transportation (ADOT)

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Document Change Control

The following is the document control for revisions to this document.

Version Number	Date of Issue	Author(s)	Brief Description of Change
1	9/13/18	Maria Burton-Sunder	N/A
2	10/9/18	Maria Burton-Sunder	• Page 5 – Add reference to Note 1 the first time ADOT's Pavement Distress Manual is mentioned • Page 7 – Add reference to Note 2 the first time AASHTO Standard R56-14 is mentioned • Page 13 – Modify the first sentence as follows: ○ "This section describes the level of data sampling…" • Page 25 – Change Title from "FHWA Division Office Pavement Engineer" to "FHWA Division Office Asset Management Engineer"

Definitions

The following are definitions of terms, abbreviations, and acronyms used in this document.

Term	Definition
AASHTO	American Association of State Highway and Transportation Official
ASTM	ASTM International formerly known as the American Society for Testing and Materials
FHWA	Federal Highway Administration
HPMS	Highway Performance Monitoring System
PM2	Performance Measures for Pavements and Bridges Rule
PSR	Pavement Serviceability Rating
QC	Quality Control
QM	Quality Management

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1. QUALITY MANAGEMENT APPROACH

The purpose of managing quality is to validate that the deliverables are completed with an acceptable level of quality. Quality management (QM) assures the quality of the data collection deliverables and describes the processes and procedures to be used for ensuring quality.

The QM Program identifies key activities, processes, and procedures for ensuring quality. Below is a brief explanation of each of the sections of the QM plan that follow.

Section 2. Data collection equipment calibration and certification	This section describes the methods in which the data collection equipment will be calibrated and certified to collect the data required by the PM2 Rule (Roughness, Rutting, Faulting, and Percent of Cracking). Each specific piece of pavement condition data collection equipment and its subsystems (e.g., DMI, GPS, or video images) shall be tested, calibrated and checked prior to initializing the pavement condition survey. Equipment certification will be based on the ability to meet existing AASHTO or ASTM standards.
Section 3. Certification process for persons performing manual data collection	State will certify that persons collecting data using a manual collection process have acceptable knowledge of their manual data collection survey procedures.
Section 4. Quality Control (QC)	The QC activities that monitor, provide feedback, and verify that the data collection deliverables meet the defined quality standards.
Section 5. Data sampling, review and checking processes	Typical data checks during the data collection process that includes network-level checks for ratings that are out of expected ranges, checks for detecting missing segments or data elements, and statistical analysis to check for data inconsistencies.
Section 6. Error Resolution Procedures and Acceptance	The State specifies the corrective action to be taken if data are not found to meet quality requirements. The corrective actions specified in the QM plan should improve data collection procedures and data quality that results in acceptance of deliverables.
Section 7. Quality Team Roles and Responsibilities	The quality-related responsibilities of the data collection team.
Section 8. Quality Reporting Plan	The documentation of all QM activities—including quality standards, QC, acceptance, and corrective actions—and the format of the final QM report.
Section 9. Acceptance of QM Program	Signature page for acceptance of the QM Plan.

2. DATA COLLECTION EQUIPMENT CALIBRATION AND CERTIFICATION

The protocols used for collection, and associated quality standards are described below. Quality standards define, when applicable, the resolution, accuracy, and repeatability or other standards that will be used to determine the quality of each deliverable.

Pavement Metric Collection Protocols

Deliverable	Protocols	Resolution	Accuracy/Certification
Ride (left, right, and average of left and right wheel-paths IRI)	AASHTO	0.0001 in/mi	The Contractor shall state in detail the repeatability of the measured values (IRI, rutting, faulting, cracking percent/length etc.). If more than one measuring vehicle are used, the reproducibility of the measuring vehicles shall be clearly stated. The contractor shall also specify the reference device/measuring vehicle for measuring values and the verification/validation test method that will be used for verifying the accuracy of the measuring vehicles.
Rut depth (average and maximum)	AASHTO/HPMS	0.0001 in	
Faulting (absolute average and maximum)	AASHTO/HPMS	0.0001 in	
Cracking percentage (per HPMS Field Manual 2016 Edition for AC, PCC, and CRCP)	HPMS	1 percent	
Cracking percentage (per ADOT Pavement Distress Manual[1] for AC, JPCP+FC, CRCP+FC)	ADOT	1 percent	
Cracking (alligator, block, longitudinal, transverse, reflective)	ADOT	1 percent 1 ft 1 (count)	
Pot Holes	ADOT	1 (count) 1 sq.ft.	
Corner breaks	ADOT	1 (count)	
Patch	ADOT	1 (count) 1 sq.ft.	
Punchouts	ADOT	1 (count)	
GPS (Latitude and Longitude)	N/A	0.00000001 degree	

Deliverable	Protocols	Resolution	Accuracy/Certification
Location of segment	N/A	0.0001 mile	The network of roadways that require reporting of pavement condition data has been pre-configured into a set of linear segment "bins" (0.1-mile segments) with from and to measure values and in X/Y two dimensional extent, that allow the reporting of roadway condition data year-after-year with the same linear geospatial proximity along any given route. The Contractor shall provide pavement condition data that is pre-configured to these bins.
Segment begin point	N/A	0.01 mi	For PMS delivery, each surveyed ADOT-owned route or ADOT-owned route segment of contiguous collection, the Contractor shall report the start point, other key reference points (landmarks) along the route, and the end point in terms of the distance from the start point for the verification of the accuracy of the traveled distances. The Contractor shall clearly state the precision and bias of the distance measurement of the measuring vehicles.
Terrestrial roadway images	N/A	minimum resolution of 1920 X 1080 pixels	Clear digital images free of distortion and sun overexposure, no part of the vehicle is visible, high resolution, include the entire roadway shoulders, include roadway signs, include as much right-of-way as practical.
Pavement surface images	N/A	minimum horizontal resolution of 4096 pixels wide across the 12 feet and shall be able to resolve 0.06 inch cracks at 60 mph	0.06 inch crack can easily be identified and recorded in automated processing

Pavement Metrics Standards and Calculations

Deliverable	Standard
Ride (left, right, and average of left and right wheel-paths IRI)	• IRI collection device in accordance with AASHTO Standards M328-14. • Certification of IRI data in accordance with AASHTO Standard R56-14(2). • Collection of IRI data in accordance with AASHTO Standard R57-14. • Quantification of IRI data in accordance with AASHTO Standard R43-13 (also in ADOT Pavement Distress Manual).
Rut depth (average and maximum)	• Collection of transverse pavement profiles in accordance with AASHTO Standard PP 70-14. • Quantification of Rut Depth values in accordance with AASHTO Standard PP 69-14, with the modifications specified in the HPMS Field Manual (also in ADOT Pavement Distress Manual).
Faulting (absolute average and maximum)	• Faulting computed based on AASHTO Standard R36-13 with the parameters specified in the HPMS Field Manual (also in ADOT Pavement Distress Manual).
Pavement surface images (for distress identification)	• Collection of pavement surface images in accordance with ADOT specifications in contract: ○ "Clear pavement images shall be collected continuously for the full lane width. The images shall show either the centerline or edge line stripe for lane position reference. The camera shall have sufficient resolution so that cracks of at least 0.06 inch can easily be identified and recorded in automated processing. The pavement shall be illuminated to remove all shadows and any seams between images. Images shall be sized and synchronized with the terrestrial roadway imagery. ○ Pavement images shall span, at a minimum, the data collection lane from left lane stripe to right lane stripe of the right-most through lane, and shall provide 100% continuous pavement coverage. Images resolution will be such that all visual cracking distresses can be accurately identified and quantified. ○ The images shall have a minimum horizontal resolution of 4096 pixels wide across the 12 feet and shall be able to resolve 0.06 inch cracks at 60 mph. "Stitching together" multiple images to achieve 100% pavement coverage is required. ○ The Contractor shall deliver synchronized pavement imagery with the terrestrial imagery." • Quantification of distresses from pavement surface images in accordance with the ADOT Pavement Distress Manual and ADOT specifications in the contract: ○ "The Contractor shall propose use of a proven, documented, and demonstrated system for the processing of collected distresses. The reduction of images and processing of distresses shall be mostly automated and consistent, with limited manual intervention to meet the requirements herein. Moreover, it is desirable that the data reduction takes place as it is being collected, so that processing time is limited following data collection. Glaring mistakes, if any, shall be brought to the attention of the Department project manager immediately and necessary corrective actions shall be taken on a timely basis."

Deliverable	Standard
Cracking percentage	• Quantification of cracking in asphalt pavement surfaces, both in wheelpath and non-wheelpath areas and at each severity level in accordance with the ADOT Pavement Distress Manual. • Computation of Cracking Percent for each pavement type in accordance with the HPMS Field Manual. • Computation of Cracking Percent for each pavement type with an asphaltic surface in accordance with the ADOT Pavement Distress Manual.
Other distresses (e.g. individual cracking types, potholes, corner breaks, punchouts etc.)	• Quantification/computation of each distress item in accordance with the ADOT Pavement Distress Manual.

Notes:

(1) ADOT's Pavement Distress Manual includes required items from the 2016 Highway Performance Monitoring System (HPMS) Field Manual, as well as additional items required from ADOT based on the 2014 Distress Identification Manual for the Long-Term Pavement Performance Program (LTPP). ADOT's Pavement Distress Manual is issued by ADOT's Pavement Management and Pavement Design sections.

(2) The number of facilities who provide profile equipment certifications is limited. Certification under the standard AASHTO R56-14 is not commonly recognized amongst profile vendors. The Texas A&M Transportation Institute (TTI), who certifies profile equipment at their pavement profiler evaluation facility, currently has no profilers listed as certified under AASHTO R56. TTI does however have a number of profilers certified under TxDOT Test Method Tex-1001-S. Because of the limited number of facilities providing certifications and limited number of profile vendors with AASHTO R56 certification, ADOT currently does not require formal certification of profile equipment under AASHTO R-56. TTI certification under the standard Tex-1001-S is acceptable. Certification from a nationally recognized pavement test facility other than TTI will be considered.

3. CERTIFICATION PROCESS FOR PERSONS PERFORMING MANUAL DATA COLLECTION

This section is to document the certification processes in-place to secure that persons performing manual data collection demonstrate basic knowledge of State manual data collection process and FHWA's Highway Performance Monitoring System (HPMS) Field Manual procedures.

All data is collected by a contractor using an automated data collection system. Condition survey data will be verified by establishing the ground truth through a manual survey performed by State staff. No formal certification will be issued; however, surveyors must review and be familiar with ADOT's Pavement Distress Manual (State Manual Pavement Condition Survey Procedures). Prior to collection, surveyors will meet to review the manual and make sure the protocol is understood. Data will then be collected manually by three surveyors. Results from each surveyor will be discussed, and the group will come to a final consensus on the ratings.

Manual Data Collection Protocols

Deliverable	Protocols	Performance Items	Certification
Data Collector Staff Certification	State Manual Pavement Condition Survey Procedures (includes required items from Highway Performance Monitoring System Field Manual)	Distress Identification (Cracking etc.)	State certifies that surveyors are familiar with the agency pavement condition survey procedures and distress identification manual based on surveyors meeting and reviewing the ADOT's Pavement Distress Manual prior to collection. Pavement is rated by three surveyors which have come to a final consensus on the rating (inter-rater check).

4. QUALITY CONTROL

The focus of QC is on data collection deliverables and processes. QC monitors the deliverables to verify that they are of acceptable quality and are complete and correct. A written QC plan will be implemented with concurrence from the data collector.

The following table identifies:

- The major deliverables that will be tested for satisfactory quality level.
- The quality expectations for the deliverables.
- The QC activities that will be executed to control and monitor the quality of the deliverables.
- How often or when the QC activities will be performed.

Quality Control Deliverables and Processes

Deliverable	Quality Expectations	Activity	Frequency
Vehicle	• Contractor shall submit a quality control/quality assurance plan to ensure an accurate and high quality level of data provided to ADOT is maintained. The plan shall include detailed information on how the Offeror will remediate any deficiencies and a relevant timeline for addressing the deficiencies. If the Offeror is proposing to utilize a subcontractor to complete QCQA, the Offeror shall indicate the name of the subcontractor, experience and qualifications of the subcontractor and the availability of the subcontractor.	Check	Pre-deployment
Data Collection Status	The Contractor shall provide mileages for the latest data collection update to assist the Department Project Manager in understanding project status during the execution of the project.	Check	Weekly
IRI	• Check repeatability of 0.1 mile left IRI value: needs to be within confidence interval, initially established from 10 runs. (Check 10 runs per 5 sites. 5 out of 5 sites need to pass.) • Check repeatability of 0.1 mile right IRI value: needs to be within confidence interval, initially established from 10 runs. (Check 10 runs per 5 sites. 5 out of 5 sites need to pass.)	Initial Verification	Entry/Re-entry
	• Check repeatability of 0.1 mile left IRI value: needs to be within confidence interval, initially established from 10 runs. (Check 1 run per 1 site. 1 out of 1 site needs to pass.) • Check repeatability of 0.1 mile right IRI value: needs to be within confidence interval, initially established from 10 runs. (Check 1 run per 1 site. 1 out of 1 site needs to pass.)	Regular Verification	Weekly

Deliverable	Quality Expectations	Activity	Frequency
Rutting	• Check repeatability of 0.1 mile left rut value: needs to be within confidence interval, initially established from 10 runs. (Check 10 runs per 4 sites. 4 out of 4 sites need to pass.) • Check repeatability of 0.1 mile right rut value: needs to be within confidence interval, initially established from 10 runs. (Check 10 runs per 4 sites. 4 out of 4 sites need to pass.)	Initial Verification	Entry/Re-entry
	• Check repeatability of 0.1 mile left rut value: needs to be within confidence interval, initially established from 10 runs. (Check 3 runs per 4 sites. 4 out of 4 sites need to pass.) • Check repeatability of 0.1 mile right rut value: needs to be within confidence interval, initially established from 10 runs. (Check 3 runs per 4 sites. 4 out of 4 sites need to pass.)	Regular Verification	Monthly
Faulting	• Check repeatability of 0.1 mile mean faulting height: needs to be within confidence interval, initially established from 10 runs. (Check 10 runs per 1 site. 1 out of 1 site needs to pass.)	Initial Verification	Entry/Re-entry
	• Check repeatability of 0.1 mile mean faulting height: needs to be within confidence interval, initially established from 10 runs. (Check 3 runs per 1 site. 1 out of 1 site needs to pass.)	Regular Verification	Monthly
Distress Identification (Cracking etc.)	• Check repeatability & accuracy of 0.1 mile distresses reported: need to be within acceptance range, initially established from 1 run and manual survey by 3 raters. (Check 1 run per 6 sites. 6 out of 6 sites need to pass.)	Initial Verification	Entry/Re-entry
	• Check repeatability of 0.1 mile distresses reported: need to be within acceptance range, initially established from 1 run and manual survey by 3 raters. (Check 1 run per 6 sites. 6 out of 6 sites need to pass.)	Regular Verification	Monthly
Imagery – Laser Crack Measurement System (LCMS) Images and Photo-Log Images	• Distresses seen in images are correctly identified in data according to ADOT Pavement Distress Manual • Uploaded images match correct location on map • Route and milepost/measure location is noted correctly	Check Uploaded Images	During Distress Identification Checks
	• Distresses and pavement type identified in data are consistent with uploaded images • Uploaded images match correct location on map • Route and milepost/measure location are noted correctly	Check viewing website with uploaded Images	Prior to delivery

To ensure repeatability, pavement measurements will be verified by repeatedly being able to stay within confidence intervals established from the average and standard deviation of 10 runs on a control site. Fifteen 1-mile length control sites and one 0.1-mile length control site (for manual survey) will be predetermined to represent different pavement conditions and pavement types throughout the state. The sites will range from “good” condition with low IRI to “poor” condition with a high IRI. The sites will be composed of asphalt, concrete, and composite (friction course on top of concrete) pavements.

All distresses measured will need to meet the standards identified in ADOT's Pavement Distress Manual (HPMS Manual included). Because of the nature of automated distress detection, the laser crack measurements system (LCMS) images from the contractor will be reviewed to ensure that cracking and other distresses are being identified sufficiently within the given images. ADOT will work with the contractor to ensure that cracking detection algorithms are adjusted accordingly when necessary.

Distress/cracking detection will be monitored for accuracy by comparing automated results with manual rating results. One control site will be used to conduct a manual survey where three raters must rate the pavement while on-site (0.1-mile section) and come to a consensus on the "ground truth" ratings according to the standards identified in ADOT's Pavement Distress Manual (HPMS Manual included). The other sites will be rated based on LCMS images provided by the contractor.

Repeatability of automated distress/cracking detection will be monitored based on acceptance ranges determined reasonable for automated equipment (analysis based on comparison against manual results and discussions on equipment capabilities with contractor).

Data collection is fully automated for asphalt distresses and semi-automated (manual editing of automated results) for some of the concrete distresses. Manual editing of some of the concrete distress results is acceptable by ADOT due to understanding of equipment capabilities.

5. DATA SAMPLING, REVIEW, AND CHECKING PROCESS

This section describes the level of data sampling, review, and checking process at the network-level that the State will use to access the reliability of the data. This section includes checks for ratings that are out of expected ranges, checks for detecting missing segments or data elements, and statistical analysis to check for data inconsistencies.

Data Sampling Checks

Data Element	Sampling % of Network	Expected Range	Annual Variability	Checking Process
Sectioning	100%	Sections are in 0.1-mile increments. In general: [ToMeasure] - [FromMeasure] = 0.1 mile. • Dataset 1, HPMS report: 0.1-mile sectioning starting from the beginning of each route. • Dataset 2, ADOT PMS (separate request): 0.1-mile sectioning starting from the beginning of each route, then sectioning is re-set at each milepost ○ if the last segment is < 0.05 miles, combine it with the previous 0.1 mile segment. ○ If the last segment is > or = 0.05 miles, keep it as a separate segment. •Dataset 3, more granular data (additional dataset): 21.12 ft (1/250th of a mile) sectioning starting at the beginning of each route. Note: pavement data is recorded starting at the beginning point of a route (measure is typically > 0 miles), not at the start of the test (measure = 0 miles)	Section can be < 0.1 mile at end of route/section.	Visual/automated data check (query in SQL)
Direction	100%	Each route has both directions.		automated data check (query in SQL)
Route Count	100%	Correct number of routes		automated data check (query in SQL)
Mileage Count	100%	Correct number of miles		automated data check (query in SQL)

Data Element	Sampling % of Network	Expected Range	Annual Variability	Checking Process
Location (Begin/End Segments)	100%	Begin and end of each segment is plotted correct. Direction/side of mainline is plotted correct		Visual
Reference System	5-10%	• RouteId and measure ([FromMeasure] and [ToMeasure]) are consistent with ADOT GIS database. • Measures line up consecutively on each continuous section when ordered by RouteId and measure. e.g. ToMeasure = lead(FromMeasure) e.g. FromMeasure = lag(ToMeasure)		Visual
Test Date	100%	Test date is for current year		automated data check (query in SQL)
Latitude, Longitude	100%	Lat/Long is in decimal degrees units. Lat is between 31-37 degrees, Long is negative and is between 109-115 degrees.		automated data check (query in SQL)
Elevation	5-10%	Elevation is not negative. Elevation max should be ≈ 10,000 ft. Elevation is correct for select areas.		Visual
Speed	100%	Speed is not more than 65 mph, and is not less than 12 mph. If speed is too low, collection should not be valid and distress information should be NULL.		automated data check (query in SQL)
Pavement type	5-10%	Pavement type is correct (e.g. flex, comp, etc.)		Visual
Bridges	5-10%	Bridges identified correctly (location, length)		Visual

Data Element	Sampling % of Network	Expected Range	Annual Variability	Checking Process
Valid Collection	100%	• [VALID_COLLECTION_AREA] = [LaneWidth] * [VALID_COLLECTION_LEN] • If valid collection length = 0, then valid collection area = 0 • Construction, bridge, and lane deviation areas have been excluded from distress measurement (see column [VALID_COLLECTION_LEN]) • If (Bridge length) or (Construction length) or (Lane Deviation length) = 528, then (Valid collection length) = 0 • In general: (Total section length) = tomeasure – frommeasure = 528 ft., unless at end of a section ***• If there are no overlapping non-valid lengths, then:*** [VALID_COLLECTION_LEN] = ([ToMeasure] - [FromMeasure])*5280 - [BRIDGE_LEN] - [CONST_LEN] - [LANEDEV_LEN] ***• If there are overlapping non-valid lengths, then:*** [VALID_COLLECTION_LEN] = ([ToMeasure] - [FromMeasure])*5280 - max([BRIDGE_LEN] ,[CONST_LEN] ,[LANEDEV_LEN]) ***Note: There may be some exceptions to this, like if all three non-valid lengths were > 0, two non-valid lengths overlap but the third non-valid length did not.***	• Note 1: rounding may cause values to be slightly different from expected . • Note 2: non-valid lengths may overlap	automated data check (query in SQL)
IRI	100%	• Check AvgIRI = average(LeftIRI, RightIRI) • IRI should not be higher than 500 in/mi • Correlated IRI should be: (ADOT IRI) = 1.0112*(Contractor IRI) + 3.6562 • IRI is reported on all pavement types and includes bridges.		automated data check (query in SQL)
Lane Width	100%	Lanewidth should be approximately between 10 – 14 feet		automated data check (query in SQL)

Data Element	Sampling % of Network	Expected Range	Annual Variability	Checking Process
Rutting	100%	• Rutting and MaxRutting should not be negative. Rutting and MaxRutting should not be more than 3 inches • Rutting is only reported on AC and composite pavements (Asphalt, JPCP+FC, CRCP+FC), not concrete, and includes bridges.		automated data check (query in SQL)

HPMS Cracking Percent	100%	For asphalt-surface pavements (Asphalt, JPCP+FC, CRCP+FC), HPMS cracking should not be more than 54% for 12 foot lane width, 59% for 11 foot lanes, or 65% for 10 foot lanes.
		
		`maximum[HPMS_Cracking] = ((39/12)*([ToMeasure]-[FromMeasure])*5280 *2)/(([ToMeasure]-[FromMeasure])*5280 *[LaneWidth])*100`
		
		`where,`
		• `wheelpath width = 39 inches`
		• `conversion in/ft = 12 in/ft`
		• `conversion ft/mi = 5280 ft/mi`
		• `# of wheelpaths = 2`
		• section length = `[ToMeasure]-[FromMeasure]`
			Note: Section length to report cracking may not necessarily be across the entire section. Need to consider valid collection length, broad pavement length, etc.	automated data check (query in SQL)

Data per Pavement Type	100%	• Check that there are values for distresses that begin with "AC_" only for pavement types: AC • Check that there are values for distress that begin with "JPCP_" only for pavement types: JPCP • Check that there are values for distress that begin with "CRCP_" only for pavement types: CRCP • Check that there are values for distress that begin with "JPCPFC_" only for pavement types: JPCP+FC • Check that there are values for distress that begin with "CRCPFC_" only for pavement types: CRCP+FC • Columns reserved for other pavement types should read NULL, not zero.		automated data check (query in SQL)

Data Element	Sampling % of Network	Expected Range	Annual Variability	Checking Process
Individual Cracking Types/Severities (e.g. Alligator, Block, low/moderate/high etc.)	5-10%	• Cracking percentages (other than HPMS cracking) should not be higher than 100%. Check select areas if cracking is reasonable. • Check between cracking types - that each cracking type was calculated as its own separate category (no double counting between cracking types). For example, a transverse crack should not also be counted as a reflective crack (should be either one or the other). • Check between cracking severity types - that each severity of cracking was calculated as its own separate category (no double counting between cracking severities). For example, an extreme crack should not also be counted as a high severity crack (should be either one or the other).		Visual
Column Totals (i.e. Cracks)	100%	Sum of cracks should equal total cracks per crack type/severity type. (e.g. sum of wheel path and non-wheel path alligator cracks = total alligator cracks per severity)	Note: rounding may cause values to be slightly different from expected.	automated data check (query in SQL)
Potholes	5-10%	Number of potholes should be a whole number. If number of potholes is more than 5 per 0.1 mile length, check if correct.		Visual/automated data check (query in SQL)
Faulting	100%	Faulting should not be more than 1 inch.		automated data check (query in SQL)
Sample Distress Inspection	5-10%	Check that IRI, rutting, cracking, and faulting values appear correct for select areas. (Review photolog/LCMS images, compare with past year's data)		Visual
Condition Ratings	5-10%	Good/fair/poor ratings appear correct for select sections.		Visual
Non-Valid Data	100%	Data that does not exist (e.g. could not test due to construction in the area) is expected to be_NULL, not zero.		automated data check (query in SQL)

Data Element	Sampling % of Network	Expected Range	Annual Variability	Checking Process
PMS Cracking Percent (ADOT)	100%	Check if ADOT's PMS percent cracking was calculated correctly (backcalculate from provided data columns)	Note: rounding may cause values to be slightly different from expected.	automated data check (query in SQL)
Broad Pavement	100%	• Broad pavement length < or = 528 ft. `[BROAD_PAVETYPE_LEN] < or = ([ToMeasure]-[FromMeasure])*5280` •Broad pavement length < or = valid collection length `[BROAD_PAVETYPE_LEN] < or =` [VALID_COLLECTION_LEN] (Note: broad pavement length is the length of continuous pavement. If there is a section with multiple pavement types, the distress of the pavement type that is the longest within the section will be reported.)		automated data check (query in SQL)
Data Completeness	100%	Are all columns requested there? (e.g. check that all distresses are there for each pavement type, severities are there for each distress type, ratings are there for each distress, … etc.)		Visual

Note: Section length to report each distress may not necessarily be across the entire section. Need to consider valid collection length, broad pavement length, etc.

6. ERROR RESOLUTION PROCEDURES AND ACCEPTANCE

The focus of acceptance is to validate that deliverables meet the established quality standards. The following table describes acceptance testing, the frequency to be performed, and corrective actions for items that fail to meet criteria.

If data or images are determined to be unacceptable by the Department, the Contractor shall be required to provide the corrected items within the duration of the scheduled data collection effort according to feedback provided through the quality review efforts by the Department.

Acceptance Testing Procedures

Deliverable	Acceptance	Acceptance Testing & Frequency	Action if Criteria Not Met
Data completeness	98 percent	Total network miles (excludes areas closed to construction)	Return deliverable for re-collection
	100 percent	Delivered data accurately populated with description information (route, direction, and begin and end latitude/longitude)	Return deliverable for correction
	98 percent	Delivered data accurately populated with required data elements. Excludes areas with expected limitations (e.g., IRI in low-speed areas or construction areas)	Return deliverable for correction
Ride (IRI)	95 percent	Weekly control site verification. Global database check for range, consistency, logic, and completeness. 5 to 10 percent sample inspection upon delivery.	Reject deliverable; data must be re-processed (or re-collected if not a processing issue)
Rut Depth	95 percent	Monthly control site verification. Global database check for consistency, logic, completeness. 5 to 10 percent sample inspection upon delivery.	Reject deliverable; data must be re-processed (or re-collected if not a processing issue)
Faulting	95 percent	Monthly control site verification. Global database check for consistency, logic, completeness. 5 to 10 percent sample inspection upon delivery.	Reject deliverable; data must be re-processed (or re-collected if not a processing issue)
Cracking Percentage	90 percent	Monthly control site verification. Global database check for consistency, logic, completeness. 5 to 10 percent sample inspection upon delivery.	Reject deliverable; data must be re-processed (or re-collected if not a processing issue)
Location of segment and segment begin point	100 percent	Plot on base map using GIS upon delivery. Global database check of accuracy and completeness.	Return deliverable for correction.

Deliverable	Acceptance	Acceptance Testing & Frequency	Action if Criteria Not Met
Panoramic and pavement images	98 percent of each control section and not more than 5 consecutive images failing to meet criteria	Monthly inspection of control verification site video. 5 to 10 percent sample inspection upon delivery.	Reject deliverable; images must be re-collected.

7. QUALITY TEAM ROLES & RESPONSIBILITIES

The following identifies the quality-related responsibilities of the data collection team and lists specific quality responsibilities.

Team Roles and Responsibilities - ADOT

Team Role	Assigned Resource	Quality Management Responsibilities
ADOT – Project Manager for Data Collection Contract	J. Meyer – Data Analytics Manager & HPMS Coordinator	• Oversee data collection contract. • Communicate weekly with data collection contractor. • Ensure timeliness of data delivery and facilitate communication between ADOT and contractor. • Provide contractor with HPMS requirements to rate the data collected per section as good/fair/poor.
ADOT – Data Group Manager	M. Cseri – Group Manager, Data Management	
ADOT – Geographic Information System (GIS) Section Manager	P. Whiteford – Geospatial Analysis Section Manager	• Perform and document checks of total mileage, segment lengths, and comparison with master route file. • Assure and document GIS checks of segment location and completeness. • Document quality audits of uploaded and processed data. Report any problems to the contractor. • Provide contractor with pre-configured linear segment “bins” to report collected data. • Ensure network data has been collected within the pre-configured “bins”.
ADOT – GIS Support	R. Blum – Spatial Information Specialist	
ADOT – GIS Support	S. Perfect – GIS Analyst	
ADOT – Data Quality Verifier, Primary Contact	M. Burton-Sunder – Pavement Performance Engineer	• Set quality standards, acceptance criteria, and corrective actions. • Analyze and verify quality of data during collection from control/verification sites. • Analyze and verify quality of network data delivered after collection. • Approve each deliverable per quality standards. • Approve resolution of quality issues. • Maintain acceptance log. • Assess effectiveness of Quality Management procedures. • Recommend improvements to quality processes. • Prepare Quality Management Program. • Prepare ADOT Pavement Distress Manual and Data Dictionary.
ADOT – Pavement Management Section Manager/Data Quality Verifier	Y. Li, Pavement Management Engineer/Section Manager	• Set quality standards, acceptance criteria, and corrective actions. • Assess effectiveness of Quality Management procedures. • Analyze and verify quality of network data delivered after collection. • Provide feedback during development of ADOT Pavement Distress Manual and Data Dictionary.

Team Role	Assigned Resource	Quality Management Responsibilities
ADOT – Data Quality Verifier	S. Weinland – Pavement Design Engineer	• Provide support as needed during analysis and verification of cracking identification during collection from control/verification sites. • Provide support as needed during development of ADOT Pavement Distress Manual and Data Dictionary.
ADOT – Data Quality Verifier	M. Mian – Pavement Preservation Engineer	• Analyze and verify quality of network data delivered after collection. • Provide feedback during development of ADOT Pavement Distress Manual and Data Dictionary.
ADOT – Data Quality Verifier & Field Crew Support	R. Fregin – Transportation Engineering Computer Applications Technician	• Analyze and verify quality of network data delivered after collection. • Assist in ADOT field data collection.
ADOT – Field Crew Manager	K. Robertson – Surface Treatment Engineer/Pavement Condition & Evaluation Manager	• Oversee ADOT field testing activities. • Provide feedback during development of ADOT Pavement Distress Manual and Data Dictionary.
ADOT – Field Crew Supervisor	S. Harvey – Transportation Engineering Specialist/Field Crew Supervisor	• Collect data on control /verification sites for ADOT reference. • Perform manual "ground-truth" surveys on control/verification sites.
ADOT – Field Crew	D. Ketterling – Transportation Engineering Technician	
ADOT – Field Crew	B. Chostner – Surface Treatment Technician	
ADOT – Pavement Type Verifier	J. Cottrell – Transportation Engineer	• Assure documented pavement types are up-to-date. • Identify pavement type changes and revise pavement type where needed.
ADOT – Pavement Type Verifier	P. Hernandez – Transportation Engineering Computer Applications Technician	• Identify pavement type changes as they appear in project history documentation.

Team Role	Assigned Resource	Quality Management Responsibilities
ADOT – Photolog & Asset[1] Coordinator (1. Assets other than pavement. E.g. pavement markings, lanes, bike lane, signs, shoulders, rumble strips, highway lighting etc.)	R. Bush – Geospatial Analyst	• Coordinate integration of contractor-hosted photolog within ADOT. • Perform video/photo acceptance checks. • Assure photolog meets the needs of ADOT. •Coordinate with contractor on an agreed collection of Data Dictionary Assets (2017) •Coordinate with contractor on an agreed collection of Data Dictionary Assets (2018) •Upon delivery, sample the Data Dictionary Assets (2017 and 2018) to test for Quality and return those datasets that do not meet those qualifications.
ADOT – Information Technology (IT) Support	M. Flahan – Sr. GIS Coordinator	• Coordinate integration of contractor data into ADOT servers. • Perform data integration checks.

Team Roles and Responsibilities - Contractor

Team Role	Assigned Resource	Quality Management Responsibilities
Contractor – Data Collection Manager, Primary Contact	A. Cowie – Regional Manager of Projects and Business Development, Fugro	• Primary contact to communicate with contractor team regarding data collection. • Report weekly to ADOT Project Manager for Data Collection Contract and ADOT Data Quality Verifier, Primary Contact. • Submit collected data to ADOT. • Resolve data rejected by ADOT. • Monitor schedule adherence. •Ensure the quality of data collected and delivered to ADOT
Contractor – Data Collection Manager, Secondary Contact	L. Gordon – Project Management Office Manager, Fugro	• Contact for data collection communication when Primary Contact is unavailable.
Contractor - Data Collection Team	(Contractor: Fugro)	Contractor shall list the key personnel who will be committed to any resulting contract(s), along with their individual responsibilities and percent of their work time that will be devoted to this contract.

8. QUALITY REPORTING PLAN

The data quality verifier will monitor quality through quality check activities, and the data collection contractor will report data quality exceptions as part of weekly status reporting, or more frequently if conditions warrant. Quality is monitored through acceptance testing, and quality issues are reported to the data collection team as soon as issues are discovered.

Depending on the distress type being verified, the contractor must pass verification checks on a weekly or monthly basis. If the run(s) exceed the accepted limits, the contractor must resolve the issue by re-processing the data submitted or re-testing the verification site. If it is determined that the site itself has changed, then the reference/"ground-truth" values measured for the site must be re-established.

Upon completion of the final week of data collection, the contractor will provide verification run(s) for the last weekly or monthly verification.

The Contractor Submittals Log is used by the data collection team to itemize, document, and track to closure items reported through quality check process.

Contractor Submittals Log (IRI example)

Week of	Submittal Date	Date Tested	Vehicle ID	Route	Direction	BMP	EMP	Run Type	No. of Runs	Results	Weekly data accepted?
6/25/2018 (tested 6/18/18-6/24/18)	7/9/2018	6/19/2018	ARAN49	S-74	E	27.00	28.00	Weekly Verification	1	FAIL	Because the run tested the following week with the same vehicle was a pass, the S-74 site will be flagged for now. It seems there may be a change in the site (possibly due to heat). Consider re-establishing the site on S-74 or dropping this site and changing to a different site.
7/2/2018 (tested 6/25/18-7/1/18)	7/9/2018	6/26/2018	ARAN49	U-60	E	206.00	207.00	Weekly Verification	1	PASS	Data up to this week accepted by ARAN49.
7/9/2018 (tested 7/2/18-7/8/18)								*Weekly Verification Due (1 run) x 1 site*			

9. AGENCY & DATA COLLECTOR QM PROGRAM ACCEPTANCE

Quality Management Program accepted by the Pavement Management Section Manager:

DocuSigned by:
Yongqi Li
0E388748EDBE411...

Yongqi Li
_______________________________________ Date: 10/15/2018 ______________________

Pavement Management Section Manager Name & Title

DocuSigned by:
Miklos Cseri
AB68FE92EC5C4C3...

Miklos Joseph Cseri
_______________________________________ Date: 10/15/2018 ______________________

Data Group Manager Name & Title

Quality Management Program accepted by the Contractor Data Collection Manager:

DocuSigned by:
D5247B0DE4DC424...

Adam Cowie
_______________________________________ Date: 10/15/2018 ______________________

Contractor Data Collection Manager Name & Title

10. FHWA QM PROGRAM APPROVAL

FHWA Division Office Asset Management Engineer Recommend Approval of State DQMP:

DocuSigned by:
Chad Matty
304333D122354F2...

Chad Matty
_______________________________________ Date: 10/15/2018 ______________________

DO Asset Management Engineer: Name

DQMP accepted by FHWA Division Administrator:

DocuSigned by:
Karla S. Petty
D89406B3488D46D...

Karla S. Petty
_______________________________________ Date: 10/15/2018 ______________________

FHWA Division Administrator: Name

NOTES